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Sheha et al.

(10) **Patent No.: US 9,137,636 B2**
(45) **Date of Patent: Sep. 15, 2015**

(54) **METHOD AND SYSTEM FOR IDENTIFYING AND DEFINING GEOFENCES**

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(51) **Int. Cl.**

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H04W 4/02	(2009.01)
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G09B 29/00	(2006.01)
G09B 29/10	(2006.01)
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(52) **U.S. Cl.**

CPC ***H04W 4/021*** (2013.01); ***G01C 21/20*** (2013.01); ***G08B 25/10*** (2013.01); ***G09B 29/007*** (2013.01); ***G09B 29/10*** (2013.01); ***H04L 67/18*** (2013.01); ***H04W 4/022*** (2013.01); *H04M 1/72572* (2013.01); *H04M 2250/10* (2013.01)

(58) **Field of Classification Search**

None

See application file for complete search history.

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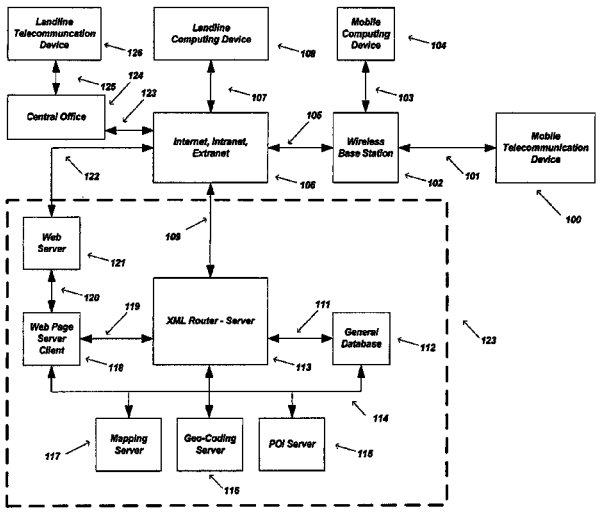
(57) **ABSTRACT**

The preferred embodiments of the present invention are directed to an improved mapping and navigational system. Specifically, the present invention is directed to a system for defining and assigning geographical boundaries to points of interests on a graphical map, where the geographical boundaries preferably correlate to spatially defined boundaries of the respective points of interests. In accordance with one embodiment of the present invention, the points of interest, along with the respective defined geographical boundaries, can be transferred from a personal computing device to a telecommunication device, such as a portable communication device, so as to be used for mapping purposes and to set off proximity alerts when the portable communication device, equipped with a GPS unit, enters or exits the geographical boundary of a particular point of interest.

23 Claims, 7 Drawing Sheets



(51) **Int. Cl.**

G08B 25/10	(2006.01)
H04M 1/725	(2006.01)

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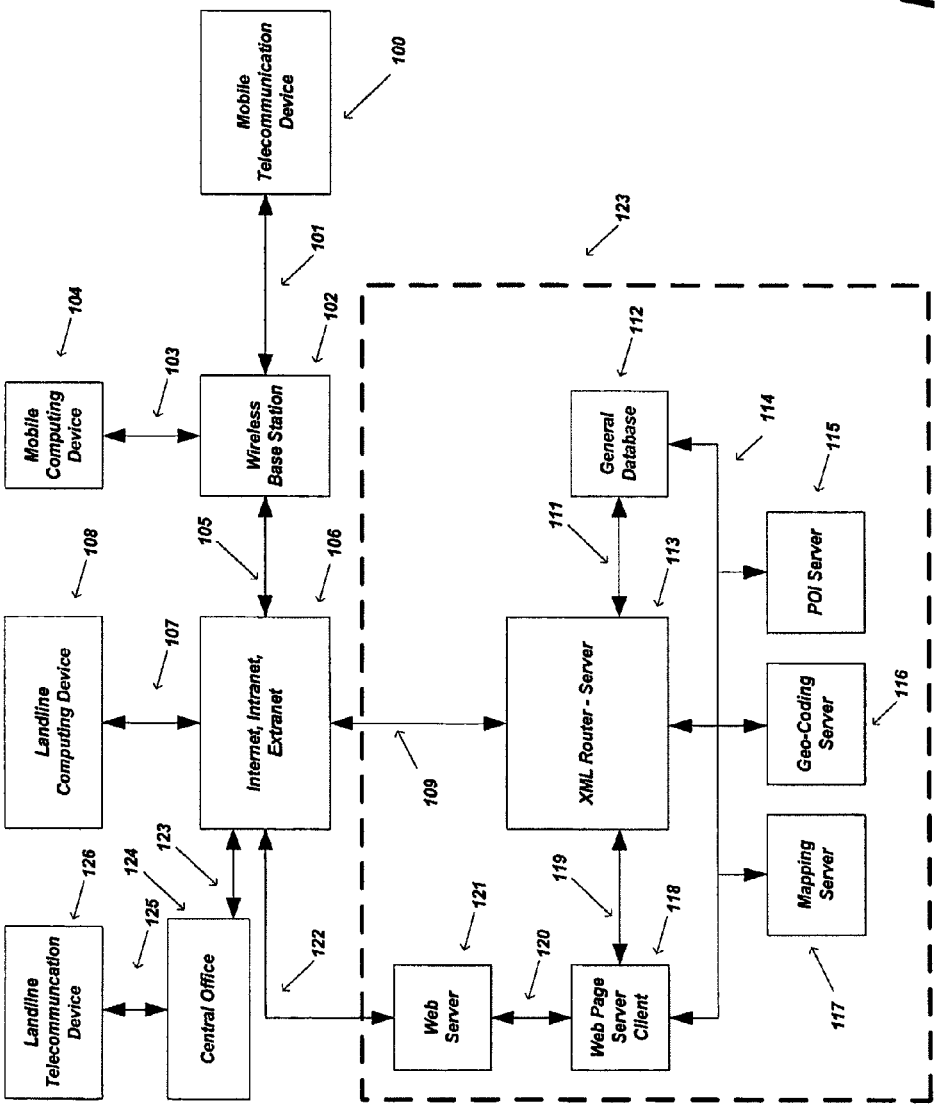
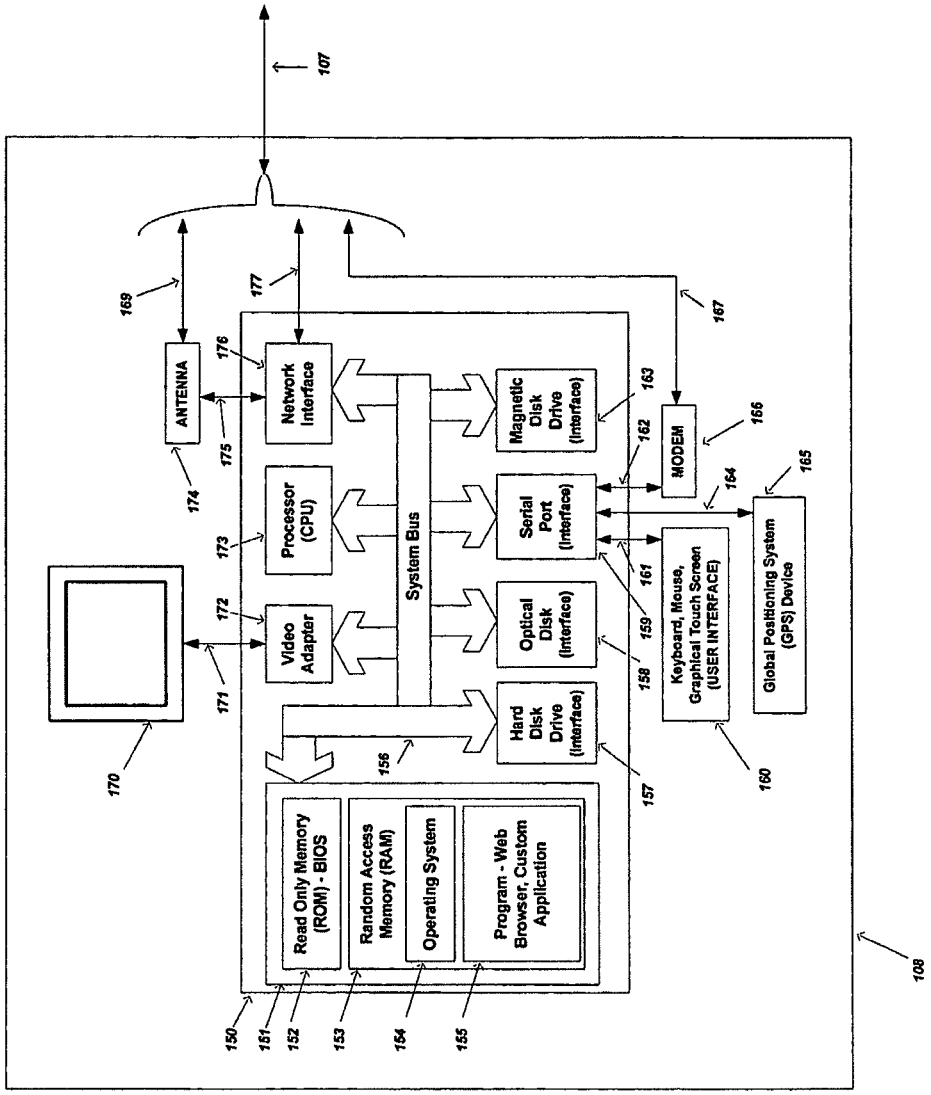

Mobile Telecommunication Device
100
101
123
104
103
102
112
Mobile Computing Device
Wireless Base Station
General Database
114
115
111
105
106
113
108
107
POI Server
Landline Computing Device
Internet, Intranet, Extranet
XML Router - Server
Geo-Coding Server
116
109
123
124
126
125
119
121
118
Mapping Server
Landline Telecommuncation Device
Central Office
122
120
Web Server
Web Page Server Client
117

FIG. 1


107
169
177
167
ANTENNA
Network Interface
Magnetic Disk Drive (Interface)
MODEM
Processor (CPU)
System Bus
Serial Port (Interface)
Video Adapter
Optical Disk (Interface)
Keyboard, Mouse, Graphical Touch Screen (USER INTERFACE)
Global Positioning System (GPS) Device
Hard Disk Drive (Interface)
Read Only Memory (ROM) - BIOS
Random Access Memory (RAM)
Operating System
Program - Web Browser, Custom Application
150
151
152
153
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108

FIG. 2

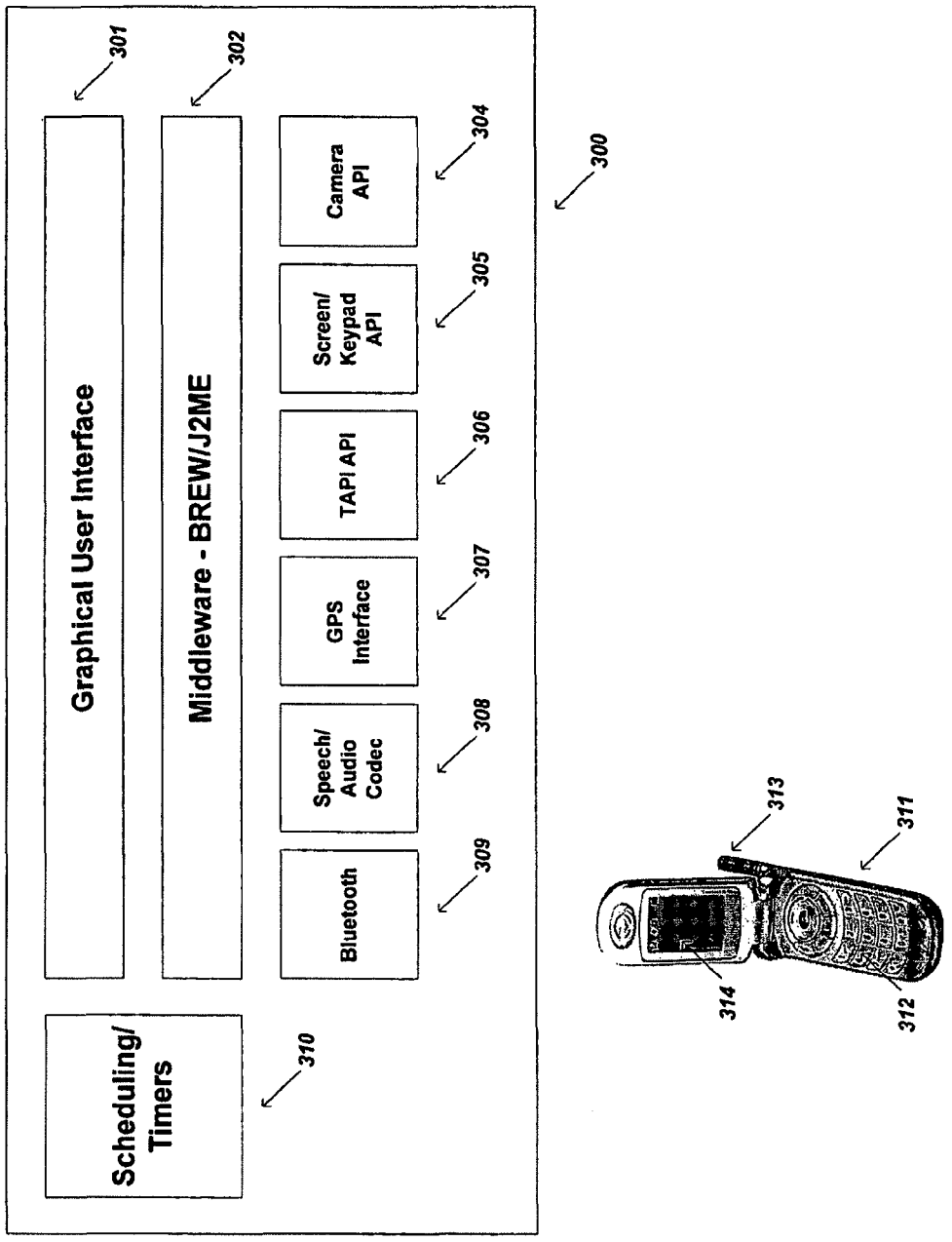
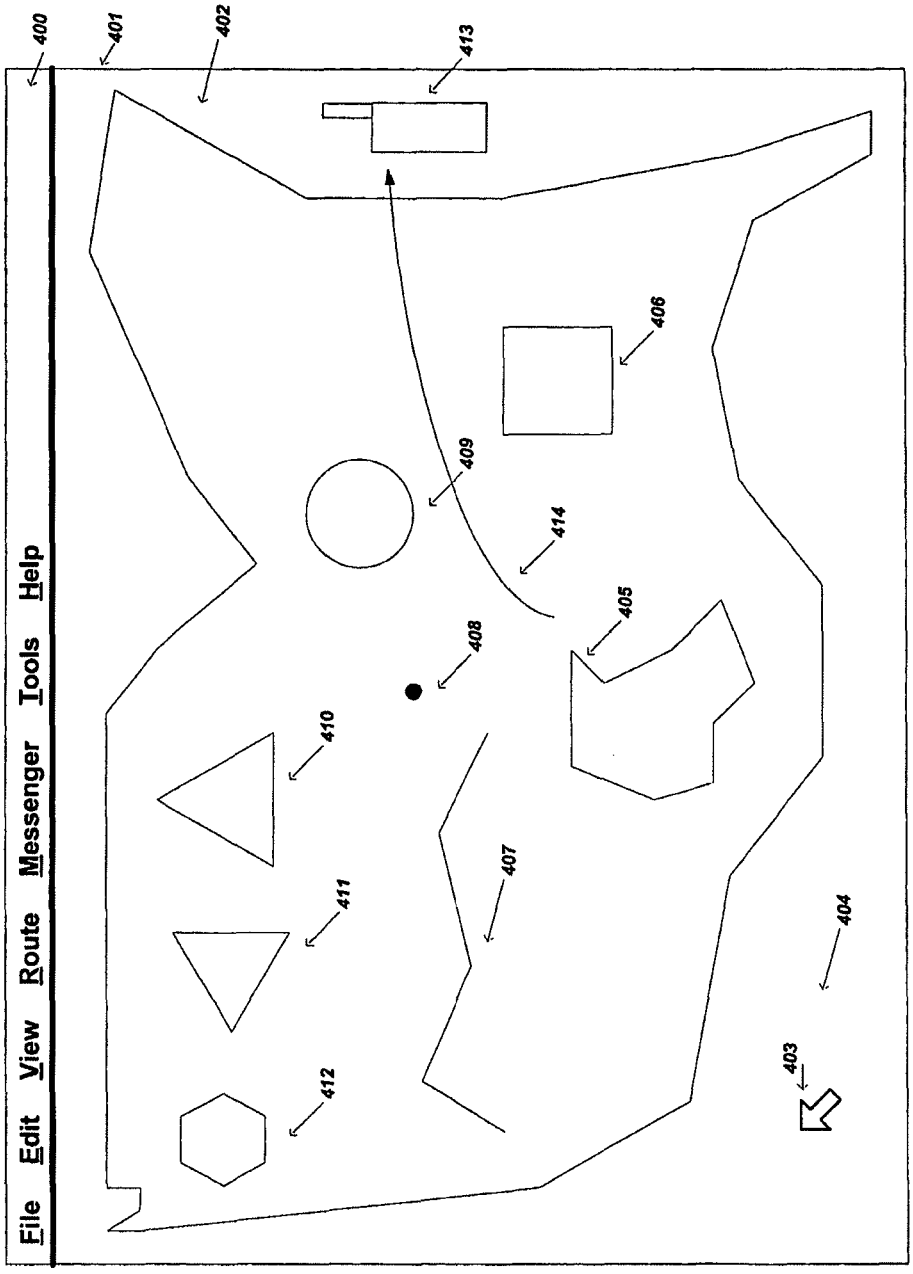

Graphical User Interface
301
Middleware - BREW/J2ME
302
Scheduling/ Timers
310
Bluetooth
309
Speech/ Audio Codec
308
GPS Interface
307
TAPI API
306
Screen/ Keypad API
305
Camera API
304
300
313
311
314
312

FIG. 3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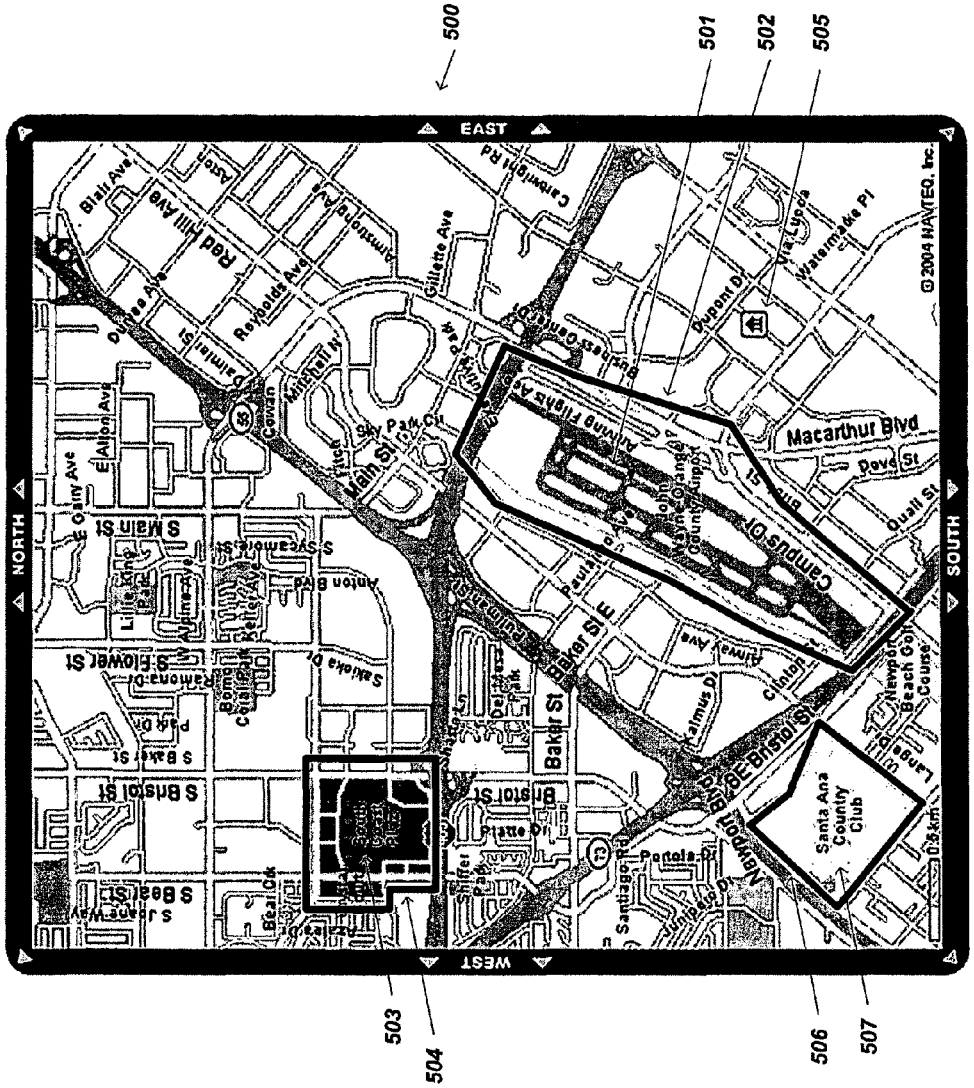
403
File Edit View Route Messenger Tools Help

FIG. 4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505
EAST
WEST
NORTH
SOUTH
Macarthur Blvd
Campus Dr
Bristol St
Baker St
Red Hill Ave
Main St
Jamboree Rd
Irvine Blvd
Santa Ana Country Club
Newport Beach Golf Course
503
504
506
507

FIG. 5

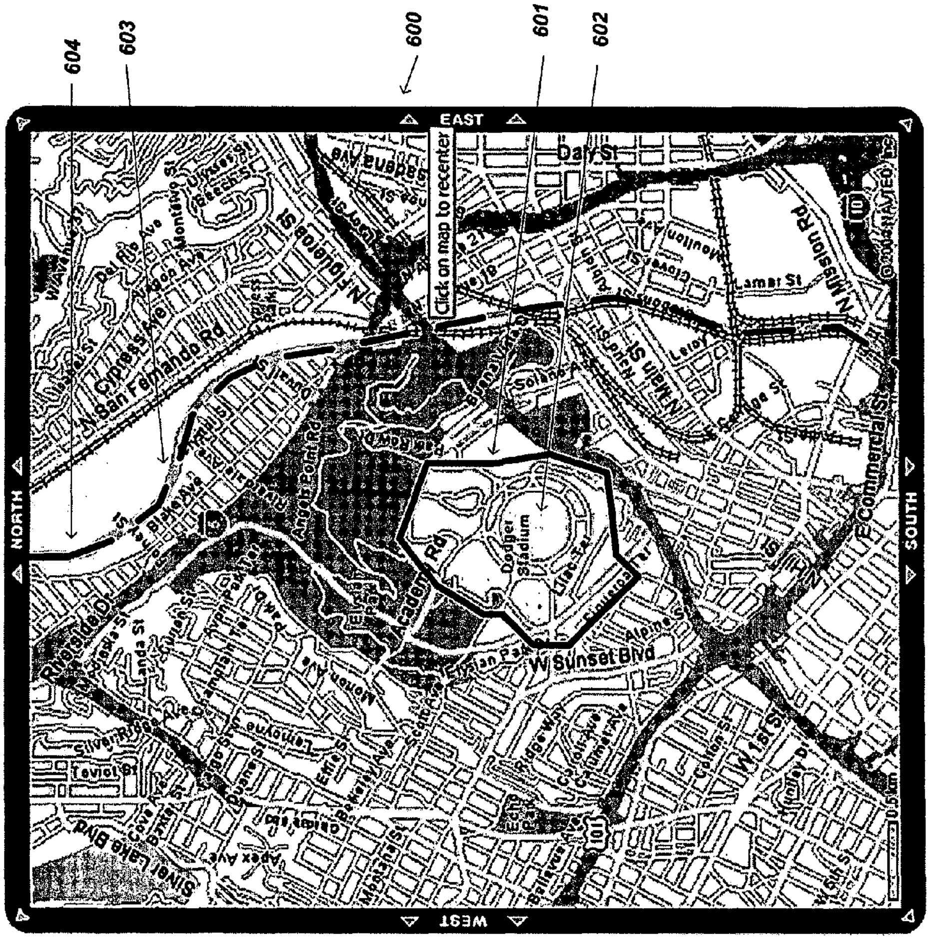
600
601
602
603
604
EAST
NORTH
SOUTH
WEST
Click on map to recenter
Dodger Stadium
W Sunset Blvd
N San Fernando Rd
Cypress Ave
N Main St
N Broadway
Angels Point Rd
Silver Lake Blvd
Riverside Dr
Day St
Lamar St
N Mission Rd

FIG. 6


700
701
702
703
704
705
706
EAST
WEST
NORTH
SOUTH
Macarthur Blvd
Bonita Canyon Dr
Jamboree Rd
San Miguel Dr
Click on map to recenter

FIG. 7

METHOD AND SYSTEM FOR IDENTIFYING AND DEFINING GEOFENCES

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a division of U.S. patent application Ser. No. 13/137,747, filed on Sept. 9, 2011, entitled "Method and System for Identifying and Defining Geofences," now U.S. Pat. No. 8,731,813; which is a continuation of U.S. patent application Ser. No. 11/370,794, filed on Mar. 7, 2006, entitled "Method and System for Identifying and Defining Geofences," now U.S. Pat. No. 8,019,532, which claims the benefit under 35 USC 119(e) of U.S. provisional patent application Ser. No. 60/659,643 filed Mar. 7, 2005, the contents of all of which are incorporated by reference herein.

BACKGROUND ART

1. Field of Invention

This present invention relates to a method and system for selecting, assigning, and creating Geofences based on using known map elements and/or point of interest (POI) data, such as parks, golf courses, schools, buildings, etc. using a plurality of user interface (UI) computing devices. Additionally, this invention combines the use of saving these Geofences on a Telecommunication Device (i.e., mobile device) that has location capability for the purpose of acting on said Geofences.

2. Description of the Related Art

Telecommunication devices, specifically wireless telephones, are achieving widespread use today. Such telecommunication devices are commonly used to establish communication between other telecommunication devices. Recently telecommunication devices are becoming more than just communication devices, but also a computing platform for executing applications similar to the early days of the personal computer era, where devices had limited memory and processing resources. The difference is that these new telecommunication devices, while currently provide a limited computing platform, also enable wireless data access to the Internet and expose the telephone's telephony functionality. These new telecommunication devices are well known to people that are skilled in the art.

Prior art systems, such as GPS enabled mobile devices, have been used in combination with Geofences, a common term to those that are skilled in the art, that defines a virtual spatial boundary (i.e., proximity range) for the purpose of creating triggers when the mobile location enabled devices enter and/or exit said boundaries. The prior art method for defining these boundaries requires the use of a graphical user interface (UI) tool for creating a polygon shaped "box" and/or trigger lines that are used to cause events to occur based on the crossing of said lines. Another prior art method of creating Geofences requires selecting a point feature, such as a latitude and longitude, and then defining either a radius or major/minor axis for the point feature in order to create a boundary around the point feature. This option can be offered using default values such that the user is required to enter little information, except the center location of the bounding box.

As people that are skilled in the art will agree, creating a geofence is a difficult spatial concept to represent in one's mind without the aid of a spatial map. Even then it is very difficult to fully represent due to map scales, etc. For example, a golf course might represent on a map an irregular shaped polygon which is hard to represent with a circle, rectangle, polygon, etc., and even more difficult to represent if a user has to draw the geofences using a GUI tool. Using such an irregularly shaped geofence is difficult for the user to establish in prior art methods, as well as difficult for inclusion into the mobile device, which will use the said geofences to act upon the required trigger events.

As people that are skilled in the art will appreciate, providing a means to significantly simplify this process to a "one-click" model would allow the use of implementing geofences for the inclusion into mass market devices, such as a wireless location-enabled cell phone, etc.

Until now, an adequate solution to these problems has eluded those skilled in the art. Thus, there exists a need to provide a solution that enables users to simply and easily create geofences that are based on real-world objects without the need to have to draw or model a geofence. For example, if a user would like to create a geofence for the "Bound Brook High School", then as those skilled in the art would appreciate, a user would only have select the map element, or in this case, the point of interest (POI), to create a geofence. This invention would correlate the spatially defined and recorded information and create a geofence boundary that emulates the actual spatially defined and recorded boundary of the object. This invention provides many important benefits for location-based applications which are an important and integral part of improving work flow and/or consumer related processes.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a method and system for enabling a very simple and efficient way to easily create and define geofences using a "one selection" process without the need to either a-priori know the extent of the object and/or define the boundary, such as using a map related object, such as a river, stream, ocean, lake, mountain, forest, reservoir, state, city, region, zip code, or the like, or using a point of interest (POI), such as a park, place of worship, school, university, restaurant, mall, or the like.

It is an object of the present invention to provide a method and system for using a "one selection" process for selecting a map or POI database that spatially represents the extents of an object. This map data and/or POI data however consists of the full and detailed spatial information that fully defines the object, such as a Park. In one embodiment, a Park feature is defined as a single and/or multiple polygon objects that fully represent the Park feature.

It is an object of the present invention to provide a method and system for allowing map related objects and/or POI objects to be represented using a plurality and various combinations of spatial representations, such as polygons, polylines, and/or point objects, to fully define the geofence that mirrors the actual map and/or POI object as accurately as possible.

It is another object of the present invention to provide a method and system for allowing map and/or POI point objects, which do not have extents, to use a default extent, such as a radius to define the objects correctly.

It is another object of the present invention to provide a method and system for allowing map and/or POI objects to automatically have varying extents based on other geofences and/or map related spatial data in the vicinity of the "selected" map or POI features for defining the extent of the object. For example, in one embodiment, a user that selects a restaurant, which is a point object, in a densely packed metropolitan area would have a default defined radius that would be much smaller than a similar restaurant in a sparse urban area. This algorithmic approach allows for a more intelligent means to create geofences for the purpose of preventing false positives,

etc., when point features are within close proximity to other geofences and/or other map objects.

It is another object of the present invention to provide a method and system for storing these "one selection" geofences onto either a single server, cluster server, or the like, or on a mobile handset device which calculates the location information for the processing of the geofence triggers. In one embodiment, a handset that calculates the location information will also store the geofence data locally for use without the need of the network, such as the Internet, Intranet, Extranet, WDN (wireless data network), EDN (engineering data network), or the like, for the processing the geofences to cause trigger events. In another embodiment, the handset would send GPS points to a single or distributed and/or clustered server system for the processing of the geofence data. The latter embodiment requires more network traffic than processing the geofence data locally, since in this invention that data is differentially synchronized to the handset, which even further mitigates the required network bandwidth for this invention.

It is another object of the present invention to provide a method and system for representing a plurality of points that define the polygon. Since multiple points make it very difficulty to fully and correctly represent the actual polygon of the map data element and/or POI element for devices with limited resources, such as memory, disk space, etc., this invention provides the capability to decimate the polygon, polyline, or the like, into its minimal representation that represents the actually map object (i.e., map element and/or POI element). This invention also provides a method to decimate the polygon, polyline, or the like, below its minimal representation in order to satiate the limited resources of the device, such as a wireless phone.

It is another object of the present invention to provide a method and system for providing an interface to input this "one selection" process. This interface can consist of, but is not limited to, voice input, IVR, text, touch pad, keyboard, mouse, multi-modal, or the like, for the purpose of defining a geofence by selecting a map data element and/or POI element. For example, in one embodiment, a user can use an IVR voice input device to say the name of the POI, such as "Pasadena High School". This would indicate to the system that a geofence would be sent to the mobile location handset that would define a geofence around "Pasadena High School". In this embodiment, when the target mobile location handset either enters or leaves this geofence, certain event alerts would be triggered that the user had previously defined for the said handset.

It is another object of the present invention to provide a method and system to allow a user to select an object on a map, such as a map element and/or POI object for adding a geofence to a mobile device. A user only has to select the object to add it to the handset within the map view. Additionally, a user can also drag-and-drop the object to the representation of the mobile device for allowing the user to easily add a geofence to a mobile location-enabled device. This enables users to quickly and easily add geofences to devices without having to worry about the actual boundary and/or draw the polygon to represent the spatial representation that requires a geofence.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** illustrates a network system for providing a communication channel between various wireless and landline computing devices;

FIG. **2** illustrates one embodiment of the present invention showing a personal computer with an integrated web browser;

FIG. **3** illustrates one embodiment of the present invention of a wireless Telecommunication Device and an accompanying high-level block diagram of a wireless Telecommunication Device;

FIG. **4** illustrates one embodiment of a map view and various polygon and polyline map and POI objects;

FIG. **5** illustrates one embodiment of the various spatial related objects and their respective geofences representations;

FIG. **6** illustrates another embodiment of the various spatial related objects and their respective geofences representations;

FIG. **7** illustrates yet another embodiment of the various spatial related objects and their respective geofences representations;

DETAILED DESCRIPTION OF THE EMBODIMENT

This present invention relates to a method and system for selecting, assigning, and creating Geofences based on using known map elements and/or point of interest (POI) data, such as parks, golf courses, schools, building, etc. using a plurality of user interface (UI) computing devices. Additionally, this invention combines the use of saving these Geofences on a Telecommunication Device (i.e., mobile device) that has location capability for the purpose of acting on said Geofences.

The present invention may be embodied in a pre-commercial (non-public) and internal application called "AtlasLink" which is owned and licensed by Networks In Motion, Inc. of Irvine, Calif.

FIG. **1** and FIG. **2** illustrate high-level diagrams of one embodiment that is a suitable computing and networking environment in which the invention may be implemented. The invention will be described in the general context of an application that executes on an operating system in conjunction with a personal computer or server, but those skilled in the art will realize that this invention may also be implemented in combination with other program modules. Program modules typically include routines, programs, data structures, etc. that perform particular tasks or implement particular abstract data types. This invention is not limited to a typical personal computer, but may also be utilized with other computing systems, such as handheld devices, mobile lap top computers, wireless phones, in-vehicle navigation systems, programmable consumer electronics, mainframe computers, distributed computer systems, etc., and the like.

FIG. **1** is a network block diagram illustrating the connection (**125** & **101**) of both wireless **100** and wired **126** Telecommunication devices to an Application Service Provider (ASP) **123**, also referred to as an online server system. This online server system may be configured at a single location and on a single computer, or can be configured as a distributed computer system and at different locations. The wireless Mobile Telecommunication Devices **100** are wirelessly connected **101** to a nearby wireless base station **102**, which are typically connected or have access to **105** the Internet, Intranet, or Extranet **106**. Additionally, a landline Telecommunication Device **126** is typically connected to a nearby central office **124** which is connected or has access to **123** the Internet, Intranet, or Extranet **106**. Additionally, the Application Service Provider (ASP) **123** also has access **109** to the Internet, Intranet, or Extranet **106**. The ASP **123** generally consists

of a front-end firewall and XML router **113** which itself has access (**111** & **114** & **119**) to other local computing modules, such as a database **112**, POI server **115**, geocoding server **116**, mapping server **117**, and webpage client server **118**. The web-server front-end **118** can be connected to the outside Internet, Intranet, or Extranet **106** either through the local front-end firewall **113**, or as in this embodiment, via **120** the web server **121**, which is connected **122** directly to the Internet, Intranet, or Extranet **106** by using a software firewall which is well known to those skilled in the art. Additionally, either mobile **104** or landline **108** computing devices, such as a personal computer, are connected to the Internet, Intranet, or Extranet **106**, either directly **107** or through a wireless connection **103** and base station **102**.

FIG. **2** illustrates a typical personal computer **150**, that includes a central processing unit (CPU) **173**, video adapter **172**, hard disk drive **157**, optical disk **158**, serial port **159**, magnetic disk drive **163**, system bus **156**, and network interface **176**→**177** & **167** & **169**→**109**. The hard disk drive **157** typically refers to a local non-volatile storage system for storing large amounts of data, such as a web browser program files or cookies or a user's Contact data. The optical disk **158** typically refers to a CD-ROM disk used for storing read-only data, such as an installation program. The serial port interface **159** is typically used to connect **161** the computer **150** to external devices **160**, such as a keyboard, mouse, and graphical touch screen interface, and also can connect **164** to positioning devices **165**, such as a GPS receiver. The keyboard and mouse **160**, amongst other input devices **165**, enable users to input information into the computer **150**. The connection **161** & **164** cables can include a serial cable or universal serial bus (USB) cable. Other input devices, that are not shown, may include a joystick, scanner, camera, microphone, or the like. The magnetic disk drive **163** is typically used to, store small amounts data, in comparison to a hard **157** or optical **158** disk drive, and typically lacks the data transfer rates of those other storage drives, but it enables both readable and writable capability. The hard disk drive **157**, optical disk drive **158**, serial port interface **159**, and magnetic disk drive **163** are all connected to the main system bus **156** of the computer **150** for transferring data. A monitor **170** or other type of display device, such as a LCD display, is connected **171** to the computer system's **150** video adapter **172**, which is connected to the system bus **156**. Additional peripheral output devices, which are not included in this embodiment, such as a printer, speaker, etc., can also be connected to a personal computer **150**. The system bus **156** also connects to the network interface **176**, central processing unit (CPU) **173**, and system memory **151**. The system memory **151** contains both random access memory (RAM) **153**, and read only memory (ROM) **152**, that typically consists of the BIOS (Basic Input/Output System) of the computer, necessary for containing basic routines that enable the transfer of information between elements within the personal computer **150**. The RAM **153** stores a number of program modules, such as the web browser and synchronization applications **155**, and the Operating System **154** of the personal computing device **150** or personal computer **150**. One example of such a program module **155** would be a web browser that is connected to the "AtlasLink" server that was previously mentioned.

FIG. **3** illustrates a next generation wireless Telecommunication Device **311** which typically includes a display **314**, an antenna **313**, and a keypad **312**. The next generation wireless Telecommunication Device **311** & **300**, as illustrated in FIG. **3**, provides a foundation **302** for running programs or applications that can access the Telecommunication Device's **311** internal interfaces, such as the Bluetooth **309**, Speech/Audio Codec **308**, GPS Interface **307**, TAPI (Telephony Application Program Interface) **306** Interface, Screen/Keypad API (Application Program Interface) or Interface **305**, Camera API **304**, or the like as well known to those that are skilled in the art. As those that are skilled in the art will appreciate, a Telecommunication Device (**300** & **311**) will also include scheduling/timers **310** for scheduling specific events as is provided with standard computing platforms. Additionally, next generation Telecommunication Devices (**300** & **311**) have graphical user interfaces (GUI) **301** for applications to allow user input using a graphical display **314**. As people skilled in the art will appreciate, these next generation Telecommunication Devices provide the means to access the Telecommunication Devices' internal APIs using a middleware **302** platform, such as J2ME or BREW, which are both well known to those skilled in the art. This simplifies the development process since there is significant support for obtaining developer access to the Telecommunication Device's internal APIs, such as the TAPI interface for making telephone calls and capturing call logs.

The preferred embodiment for illustrating a mapping interface is shown in FIG. **4**, this typically consists of a mapping program and/or web browser **401**, a toolbar **400**, a canvas for the map **402** & **404**, a cursor for selecting objects **403**. Contained in the map are a plurality of map objects **405** & **406** & **407** & **408** & **409** & **410** & **411** & **412** which have some shape to them that can be represented by a geofence. A user is able to select a map object, by which in this preferred embodiment a user would use a cursor **403**, and then add it to a mobile device. In another embodiment, a user selects the map object **405** and then drags-and-drops **414** the object onto a representation of the mobile handset **413**. In this embodiment, this operation will send the actual representation of the geofence to the mobile device. As those skilled in the art will appreciate, a geofence sent to the device will also incorporate a slight buffer region in order to mitigate false positives, which can be remotely configured on a device-by-device basis.

In another embodiment a user can select a category from a directory or Yellow Pages, such as parks. The results would return a list of parks, such as, but not limited to:

1. Yosemite National Park
2. Rocky Mountain Park
3. Big Bear

A user would then only need to select the desired park in the list using a standard GUI interface for the device, which can consist of a touch screen, rocker control (as used on a wireless device), etc. After the selection has been made, the geofence would be scheduled to be polled or pushed to the mobile location device for user-defined geofence event alerts.

As shown in FIG. **5**, there are a number of map objects shown in a map view **500** that can be represented using this "one selection" process, such as an Airport **501**, Mall **503**, Country Club **507**, and an office at an address **505**. When each one of these objects are "selected" using a plurality of means described in this invention, this invention's preferred embodiment for adding these geofences is to use the Douglas-Peucker algorithm to decimate the polygon, polyline, etc., to a minimal representation that outlines the desired spatial object, and for that decimated information to be sent to the mobile location device for geofence triggering.

FIG. **6** illustrates other polygon and polyline items that can be geofenced from a map view **600**, such as Dodger Stadium **602** and its geofenced representation **601**. Additionally, a polyline, such as a river **603** can also have a geofenced representation **604** illustrated by a dashed line in this embodiment. For a polyline, a geofenced polygon and/or polyline with a boundary distance of D distance units that are perpen-

dicular to the polyline that creates the geofenced boundary can be created for use in event alerts, etc., defined by the user.

FIG. **7**, illustrates various additional polygons **701** & **706** & **703** in a map view **700** and their respective geofenced representations **702** & **705** & **704** that are created using this "one selection" process for defining a geofenced boundary.

It should be noted that the present invention may be embodied in forms other than the preferred embodiments described above without departing from the spirit or essential characteristics thereof. The specification contained herein provides sufficient disclosure for one skilled in the art to implement the various embodiments of the present invention, including the preferred embodiment, which should be considered in all aspect as illustrative and not restrictive; all changes or alternatives that fall within the meaning and range or equivalency of the claim are intended to be embraced within.

What we claim:

1. A method of triggering a geofence event, comprising:

generating, via a physical network server, geofence data associated with a geofence pre-defined for a point of interest (POI) on a physical electronic map, said geofence being a virtual spatial boundary associated with a population density surrounding said point of interest (POI); and

displaying, to a user of a mobile device, an image corresponding to said geofence when said mobile device enters an actual geographical area corresponding to said geofence;

wherein a default extent associated with said geofence is varied in accordance with said population density.

2. The method of triggering a geofence event according to claim **1**, further comprising:

sending said geofence data to said mobile communication device.

3. The method of triggering a geofence event according to claim **1**, wherein:

said generating is performed in response to a user selection based on a spatial representation displayed on an electronic map.

4. The method of triggering a geofence event according to claim **1**, further comprising:

representing said geofence as a spatial representation displayed on a handset within a map view.

5. The method of triggering a geofence event according to claim **1**, wherein:

said geofence is a virtual fixed boundary.

6. The method of triggering a geofence event according to claim **4**, further comprising:

displaying a point of interest on said physical electronic map.

7. The method of triggering a geofence event according to claim **1**, wherein:

said particular location is associated with a particular point of interest.

8. The method of triggering a geofence event according to claim **1**, further comprising:

providing a handset within a map view including one or more points of interests displayed; and

designating one of said one or more points of interest on said physical electronic map as being associated with a fixed location on said physical electronic map.

9. The method of triggering a geofence event according to claim **1**, wherein:

said point of interest is at least one of a business establishment, religious establishment, recreational establishment, and educational establishment.

10. The method of triggering a geofence event according to claim **1**, further comprising:

establishing a communication link with a wireless communication network; and

sending said geofence data to said mobile communication device over said wireless communications network to enable a location-based application that generates said notification.

11. The method of triggering a geofence event according to claim **2**, further comprising:

decimating said geofence data before said sending to said mobile communication device.

12. The method of triggering a geofence event according to claim **11**, wherein:

said decimation is performed using a Douglas-Peucker algorithm.

13. A method of triggering a geofence event, comprising:

generating, via a physical network server, geofence data associated with a geofence pre-defined for a point of interest (POI) on a physical electronic map, said geofence being a virtual spatial boundary associated with a population density surrounding said point of interest (POI); and

displaying, to a user of a mobile device, an image corresponding to said geofence when said mobile device exits an actual geographical area corresponding to said geofence;

wherein a default extent associated with said geofence is varied in accordance with said population density.

14. The method of triggering a geofence event according to claim **13**, further comprising:

sending said geofence data to said mobile communication device.

15. The method of triggering a geofence event according to claim **13**, wherein:

said generating is performed in response to a user selection based on a spatial representation displayed on a handset within a map view.

16. The method of triggering a geofence event according to claim **13**, further comprising:

representing said geofence as a spatial representation displayed on a handset within a map view.

17. The method of triggering a geofence event according to claim **13**, wherein:

said geofence is a virtual fixed boundary.

18. The method of triggering a geofence event according to claim **16**, further comprising:

displaying a point of interest on said physical electronic map.

19. The method of triggering a geofence event according to claim **13**, wherein:

said particular location is associated with a particular point of interest.

20. The method of triggering a geofence event according to claim **13**, further comprising:

providing a handset within a map view including one or more points of interests displayed; and

designating one of said one or more points of interest on said physical electronic map as being associated with a fixed location on said physical electronic map.

21. The method of triggering a geofence event according to claim **13**, further comprising:

establishing a communication link with a wireless communication network; and

sending said geofence data to said mobile communication device over said wireless communications network to enable a location-based application that generates said notification.

22. The method of triggering a geofence event according to claim **14**, further comprising:

decimating said geofence data before said sending to said mobile communication device.

23. The method of triggering a geofence event according to claim **22**, wherein:

said decimation is performed using a Douglas-Peucker algorithm.

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